The Veliger 35(3):165–176 (July 1, 1992)

THE VELIGER

Laevipilina antarctica and *Micropilina arntzi*, Two New Monoplacophorans from the Antarctic

by

ANDERS WARÉN

Swedish Museum of Natural History, Box 50007, S-104 05 Stockholm, Sweden

AND

STEFAN HAIN

Alfred Wegner Institut für Polar- und Meeresforschung,
Columbusstrasse, D-2850 Bremerhaven, Germany

Abstract. Two new monoplacophoran species, *Laevipilina* ***antarctica*** and *Micropilina* ***arntzi***, are described from a depth of 191–742 m in the Lazarev Sea and eastern Weddell Sea. *Laevipilina* ***antarctica*** closely resembles the previously described species of *Laevipilina* McLean, 1979, and differs mainly in the convexity of the shell and in minor details of radular morphology. The stomach and the intestine of *L.* ***antarctica*** contained fine bottom sediment. The specimens range in length from 1.2 to 3.0 mm and the number of leaflets on the gills increases during ontogeny. *Micropilina* ***arntzi*** is the first live-taken species of its genus, and it is also the smallest known monoplacophoran, with a maximum shell length of 0.92 mm. It broods the young in the distal part of the oviduct and the pallial groove, and they are born at a size of 300 μm shell diameter. Both species were found on sediment bottoms with stones and shells, on which they evidently live.

INTRODUCTION

The number of known Recent species of the class Monoplacophora has slowly but steadily risen since the first discovery of a living species by the *Galathea* Expedition in 1952. The number has now reached 17, and we list them (Table 1) and plot their distribution (Figure 1). In addition, there are a few records of unidentified specimens that are also mapped.

The specimens reported here are the first records of Monoplacophora from Antarctica. ROSEWATER (1970) reported an undescribed species from the Scotia Ridge (54°44′S, 55°33′W; Figure 1, number 6), southeast of the Falkland Islands, in 1647–2044 m depth. This locality is, however, separated from the Antarctic continental rise by depths exceeding 3000 m. We have examined this specimen (U.S. National Museum of Natural History, Division of Mollusks, No. 680431): it does not belong to *Laevipilina* or *Micropilina,* but seems to be a young specimen, perhaps of *Neopilina,* since the prismatic layer has a primarily radial orientation, rather than the neatly concentric arrangement of conspicuous prisms typical for *Laevipilina.*

FILATOVA *et al.* (1975) reported *Neopilina* sp. from the same area (56°29′S, 50°51′W; Figure 1, number 3) at 4664–5631 m depth. This specimen was later described as *Neopilina* (*Lemchephyala*) *rebainsi* Moskalev *et al.,* 1983. That record is, however, also from north of the Antarctic continental rise.

Two specimens of the *Laevipilina* species described herein were found attached to rocks, but most of these and all specimens of the new *Micropilina* species were recovered from sorting sediment samples that had been sieved on board the R/V *Polarstern,* on a 0.5-mm-mesh sieve, and preserved in 95% ethanol. This explains the rather poor preservation of most specimens. Preservation in 10% formalin, buffered with 10 g of sodium-tetraborate per liter sample volume and added to the final sample, would have given a better result, especially if the container had been shaken a few times during the first two or three days.

The discovery that *Micropilina* ***arntzi*** is a brooder does not give any clues about the larval development of other monoplacophorans of which the apical area has been il-

Table 1

Distribution of Recent Monoplacophora.

No.	Species name and references†	Condition‡	Locality	Depth (m)	Size (mm)
1	*Neopilina galatheae* Lemche, 1957	l	Off Costa Rica, 09°23′N, 89°32′W	3591	29–37
	Menzies & Layton 1962	l	Off Costa Rica, 10°07′N, 89°50′W	3718	
2	*N. bruuni* Menzies, 1968	l	Off Peru, 08°54′S, 80°41′W	4823–4925	15
3	*N. rebainsi* Moskalev et al., 1983	l	SE of Falkland Is., 56°29′S, 50°51′W	4664–5631	18
4	*N.* sp.	l	Off Peru, 08°46′S, 80°44′W	3909–3970	
	Menzies (1968)	l	Off Peru, 11°30′S, 79°25′W	6146–6354	
		l	Off Peru, 08°52′S, 80°47′W	6313–6146	
5	*N.* sp.	l	Off N Chile, 23°50.0′S, 71°06.0′W	4600	5
	Moskalev *et al.* (1983)				
6	*N.* sp.	l	SE of Falkland Is., 54°44′S, 55°33′W	1627–2044	2.3
	Rosewater (1970)				
7	*Adenopilina adenensis* (Tebble, 1967)	l, r	Off South Yemen, 13°50′N, 51°47′E	3950–3000	10.7
8	*Vema ewingi* (Clarke & Menzies, 1959)	l	Off Peru, 07°35′S, 81°24′W	5817–5834	25
		l	07°30′S, 81°25′W	5841–5854	
		l	10°13′S, 80°05′W	6324–6329	
		l	12°02′S, 79°08′W	5607–5614	
	Menzies (1968)		Off Peru, 08°25′S, 81°05′W	6260–6052	
			08°20′S, 81°04′W	6260–6364	
			08°16′S, 81°05′W	6156–6489	
			11°30′S, 79°25′W	6146–6354	
			08°10.5′S, 81°08.1′W	6002	
9	*Vema bacescui* (Menzies, 1968)	l	Off Peru, 08°44′S, 80°45′W	5986–6134	28
10	*Laevipilina hyalina* (McLean, 1979)	l	Off California, 32°41′N, 119°32′W	174–384	3
11	*L. rolani* Warén & Bouchet, 1990	l	Off Spain, 42°52′N, 11°51′W	985–1000	2
12	*L. **antarctica*** Warén & Hain, herein	l, r	Weddell and Lazarev seas, Antarctica	210–644	3.0
13	*Rokopella oligotropha* (Rokop, 1972)	l	Mid-Pacific, 30°05′N, 156°12′W	6065–6079	2.6
14	*R. zografi* (Dautzenberg & Fischer, 1896)	d	Azores	1385–1600	3.7
	Cesari *et al.* (1987)	d	Mediterranean, NE of Corsica	180–500	
	Cesari *et al.* (1987)	d	Mediterranean, E of Sardinia	480–900	
15	*R. goesi* (Warén, 1988)	d	Caribbean, Virgin Islands	360–540	1.7
16	*R. veleronis* (Menzies & Layton, 1963)	l	Baja California, 27°52′N, 115°45′W	2730–2769	2.6
17	*Micropilina minuta* Warén, 1989*	d	Iceland, 63°23′N, 13°25′W	770–926	1.0
18	*M. tangaroa* Marshall, 1990	d	N of New Zealand, 31°31′S, 172°50′E	1216–1385	1.5
19	*M. **arntzi*** Warén & Hain, herein	l, d	Lazarev Sea, Antarctica	191–765	2.6
20	*Monoplacophorus zenkewitchi* Moskalev *et al.*, 1983	l, r	W of Hawaii, 20°41.7′N, 170°52.9′W	2000	4.8

† "Author comma date" indicates original description and records therein; "Reference (date)" are additional records.
‡ l—found alive; d—only shells found; r—found attached on rocks.
* Also known as a Pleistocene fossil from deep-water deposits in Reggio Calabria, southern Italy (Taviani, 1990).

lustrated (Warén 1988, 1989), although it seems likely that *M. minuta* also is a brooder, judging from the similar shape and size (340 μm) of the apical area.

Specimens of the two new species are at present being investigated anatomically by G. Haszprunar (Innsbruck).

Recently it has been advocated, especially in the paleontological literature (see, for example, Peel [1991] and references therein), that the name Monoplacophora should be abandoned. The reason given is that the concept of the name has changed considerably since its introduction.

The name Monoplacophora was introduced by Odhner in Wenz, 1940, for the superfamily Tryblidioidea. It was intended to be of the same rank as Polyplacophora and conceived to contrast the Polyplacophora. This stabilizes the name as the name of the class containing *Tryblidium* Lindström, 1880, and its type species *T. reticulatum* Lindström, 1880. The name Monoplacophora has since been extensively used to include Trybliodioidea (*sensu* Wenz) as the most important taxon. Later some authors have added and removed smaller groups of Paleozoic mollusks. We do not consider such changes in the concept of a taxon to be a convincing reason for changing its name. We have not noticed that the proponents for abandonment have suggested changing the name Gastropoda, another class that has been exposed to similar transfers of Paleozoic taxa.

The following abbreviations for institutions are used in the text: SMF—Senckenbergisches Museum und Forschungsinstitut, Frankfurt; SMNH—Swedish Museum of Natural History, Stockholm.

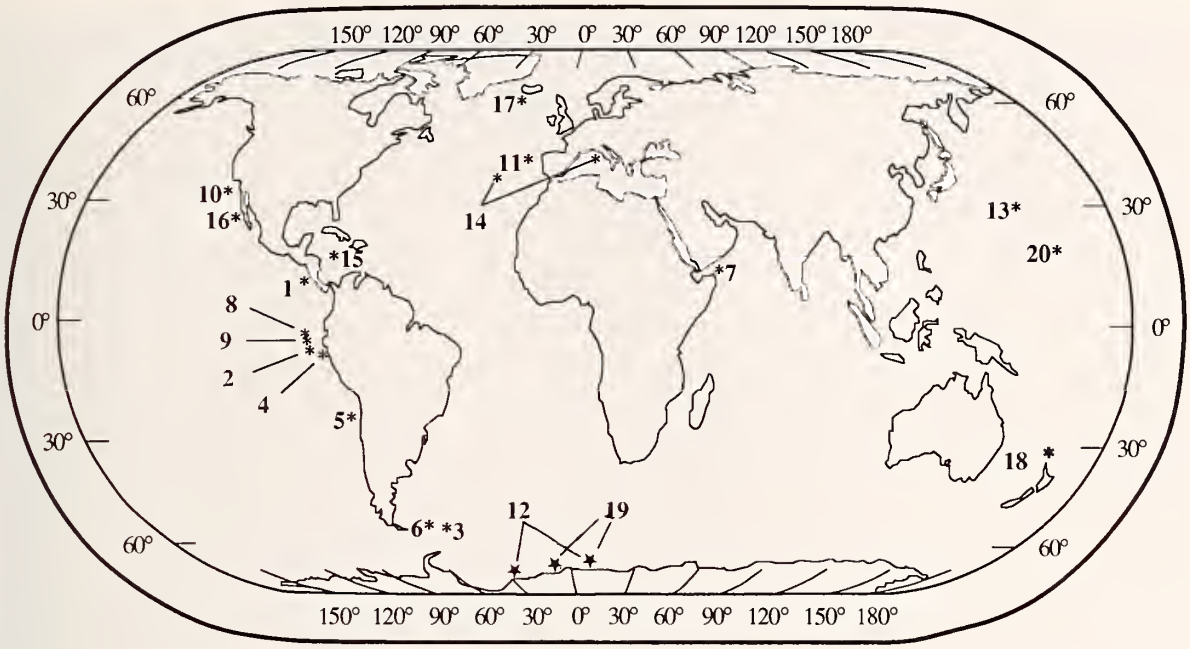


Figure 1

Map showing distribution of Recent Monoplacophora, based on Table 1.

Laevipilina McLean, 1979

Vema (*Laevipilina*) McLean 1979:9. Type species, *V.* (*L.*) *hyalina* McLean, 1979, by original designation. Type locality, off Lower California, 373–384 m.

Remarks: Moskalev *et al.* (1983) considered *Laevipilina* to be a valid genus and made a new family for it. Warén (1989) considered *Monoplacophorus* Moskalev, 1983 (type species *M. zenkewitchi* Moskalev *et al.*, 1983) to be a synonym of *Laevipilina,* but has since changed his opinion; *Monoplacophorus* can probably be considered a valid genus, differing from *Laevipilina* by its more depressed shape. Warén & Bouchet (1990) reviewed current knowledge about *Laevipilina* and described *Laevipilina rolani,* a new species from off northwestern Spain in 1000 m depth.

Laevipilina ***antarctica*** Warén & Hain, sp. nov.

(Figures 2–5, 6–8, 10–14, 15–16, 19, 27)

Type material: Holotype (Figure 3), SMF 309243, and 2 broken paratypes (radula extracted) SMF 309244; 4 paratypes (1 sectioned) from station 248, SMNH 4285, 1 from station 158, SMNH 4352.

Type locality: *Polarstern* Expedition ANT VII/4, station 245, 75°40.4′S, 029°37.2′W, 480 m, 3 specimens. Sand and gravel with stones and rich megafauna (see Arntz *et al.*, 1990).

Materials examined: The type material and:

—*Polarstern* Expedition ANT VII/4, station 248, 74°39.3′S, 029°34.4′W, 600 m, sand and gravel with stones and rich megafauna (see Arntz *et al.*, 1990), 4 specimens (1 specimen serially sectioned, 3 specimens left in alcohol).
—*Polarstern* ANT IX/3, station 158, 72°21.8′S, 16°51.2′W to 72°21.0′S, 16°48.6′W (end of haul), 623–539 m, 1 specimen, 1.26 mm diameter, on a stone of 15 cm diameter.
—*Polarstern* ANT IX/3, station 174, 69°43.7′S, 10°44.7′E to 69°42.4′S, 10°47.5′E, 432–432 m, silt with small stones, 1 specimen, 1 shell.
—*Polarstern* ANT IX/3, station 180, 69°57.4′S, 06°19.0′E to 69°57.7′S, 06°21.0′E, 280–298 m, 1 specimen, 2.4 mm diameter.
—*Polarstern* ANT IX/3, station 207, 69°57.4′S, 05°08.4′E to 69°57.5′S, 05°00.4′E, 213–210 m, silt with scattered stones with rich megafauna, large quantities of the brachiopod *Magellania fragilis* Smith, 1907, 1 specimen, 2 shells.
—*Polarstern* ANT IX/3, station 212, 70°00.5′S, 03°56.4′E to 70°00.4′S, 03°57.3′E (end of haul), 568–644 m, 1 specimen, 3.0 mm diameter, on a boulder of 80 cm diameter, 4 specimens and 1 shell free in sediment.

Description: The shell (Figures 2–5) is small, fragile, depressed, and transparent with a flat peristome. The apex (Figure 2) is slightly mamillate, forms an angle of about 60° with the basal plane, and is situated slightly behind the anterior margin. The apical area measures 230 × 190 μm and has no distinct sculpture, only some regularly shaped impressions. Outside this area commences a uniform, concentric sculpture of low, raised ridges, formed by the concentric arrangement of the prisms of the prismatic

Explanation of Figures 2 to 5

Figures 2–5. *Laevipilina* ***antarctica*** Warén & Hain, sp. nov., shell.

Figure 2. Lateral view of apex. Scale line 50 μm. *Polarstern* station 158.

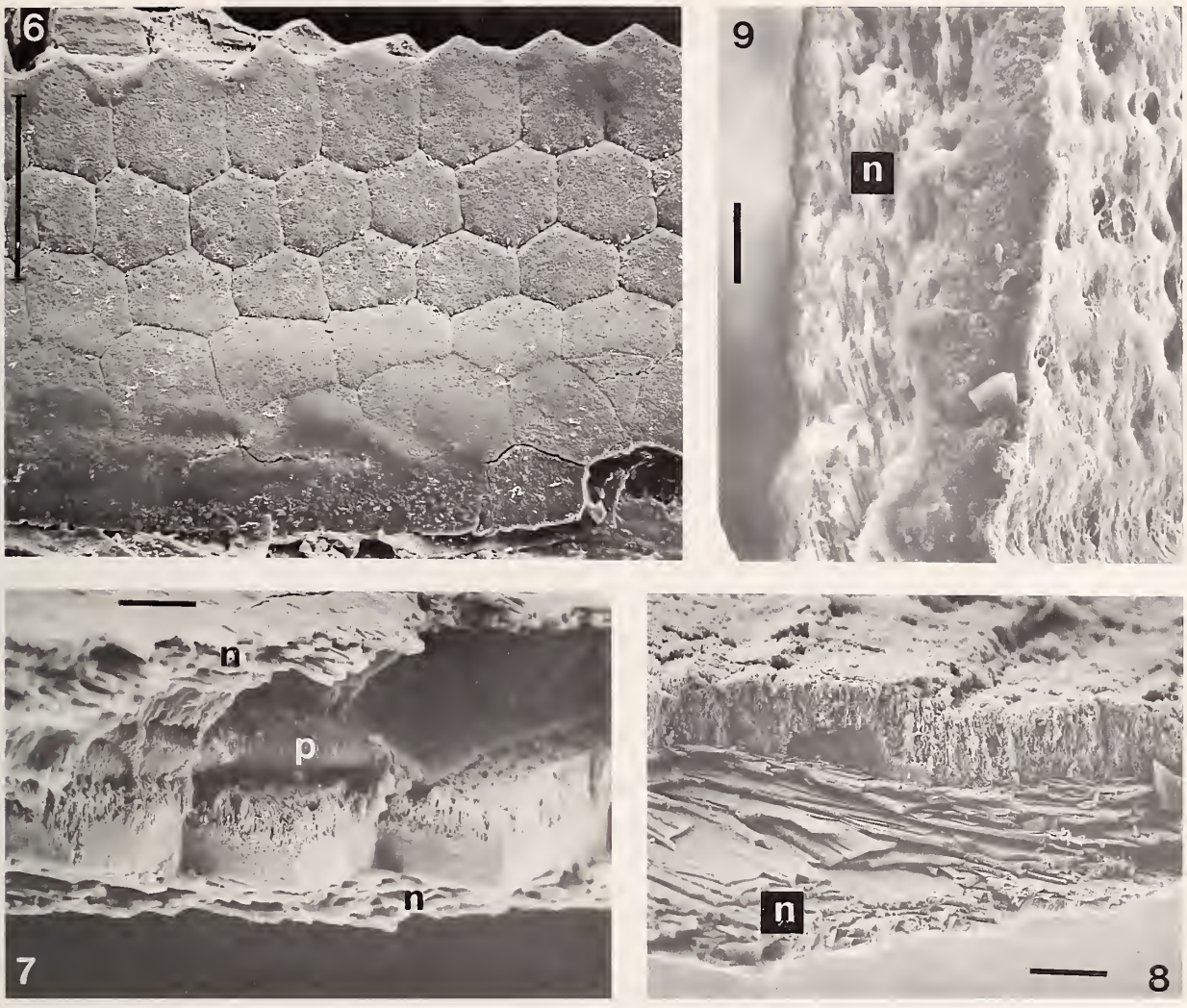
Figure 3. Dorsal view of holotype, periostracum removed. Length 2.06 mm.

Figures 4 and 5. Dorsal and lateral view, periostracum left. Length 1.26 mm. *Polarstern* station 158.

layer, which also form indistinct and fragmentary radial ridges. The shell is rather low, with the posterior surface evenly convex and the highest point situated somewhat behind the apex. The prisms (Figures 6–8) are regularly hexagonal and have a diameter of about 30 μm and a height of about 15 μm. Towards the edge of the shell they are larger and less uniformly shaped (Figure 6). The thickness of the nacreous layer (Figures 7, 8) is 5–10 μm, and it starts only a short distance from the margin of the shell. The periostracum is rather thick and tough.

Dimensions. Holotype, length 2.06, breadth 1.76, and height of shell 0.50 mm. Maximum length of the shell 3.0 mm.

Soft parts (Figures 15, 16, 19). The velar lobes are well developed and strongly ciliated. The anterior lip is conspicuous and evidently rather thinly cuticularized. The



Explanation of Figures 6 to 9

Figures 6–8. *Laevipilina* ***antarctica***, shell structure.

Figure 6. Interior view of edge of shell (facing lower edge of figure). Scale line 50 μm. Figure 7. Fragment of shell, folded double and held together by the periostracum (p). Prismatic layer partly dissolved between periostracum and nacre (n). Scale line 10 μm. Figure 8. Fragment of shell, prismatic layer (p) partly dissolved, nacreous (n) layer intact. Scale line 10 μm.

Figure 9. *Micropilina* ***arntzi*** Warén & Hain, sp. nov., shell structure. Fragment of shell, exterior surface facing right. Nacreous layer (n) well developed. Scale line 10 μm.

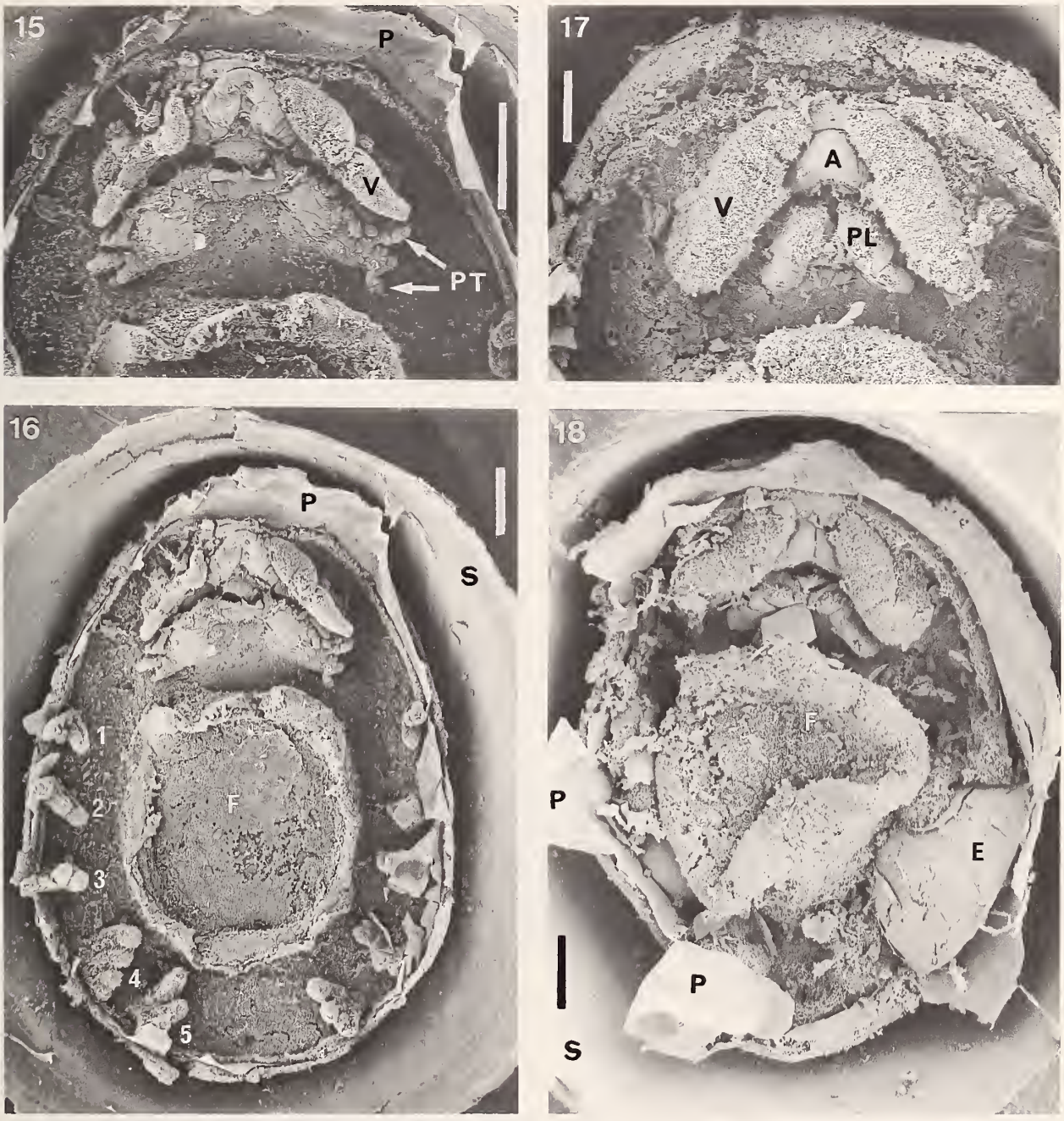
postoral tentacles are much less developed compared with *Laevipilina rolani*, and are more similar to those in *L. hyalina*. They are short and claviform and equipped with about 7 short and stumpy distal appendages. The gills are not well preserved, but the smallest specimen (1.1 mm) has four pairs of gills with 0 (anterior pair), 0, 1, and 1 (posterior pair) "digits," respectively. The largest specimen (from station 212; Figure 19) is well preserved. It has 3, 4, 4, 4, and 4 digits, respectively, on the gills starting with the anterior one. The foot (contracted) measures 1.5 × 0.9 mm. The gonads are visible, by transmitted light, as a large, lobate, dorsal sac along each side of the animal. The anus does not open on a papilla, but is a simple opening in the pallial furrow. The four coils of the intestine could not be discerned by transmitted light.

Radula (from a 1.5 mm specimen; Figures 10–14, 27). Length 1.6 mm, width 0.066 mm, with about 65 transverse rows, each of 11 teeth. The outermost tooth (assigned number 6) has no distinct cusp, and an only slightly uneven cutting edge. Tooth number 5 is large, fan-shaped, and

Explanation of Figures 10 to 14

Figures 10–14. *Laevipilina* ***antarctica***, radula. Figure 10. Posterior view. Figure 11. Anterior view. Figure 12. Vertical view. Figure 13. Detail of central tooth, posterior view. Figure 14. Newly formed section of radula. Notice the incompletely formed fourth and fifth tooth.

Numbers indicate the order of the teeth; the central tooth is 1. Scale lines are 10 μm except Figure 13, which is 5 μm.

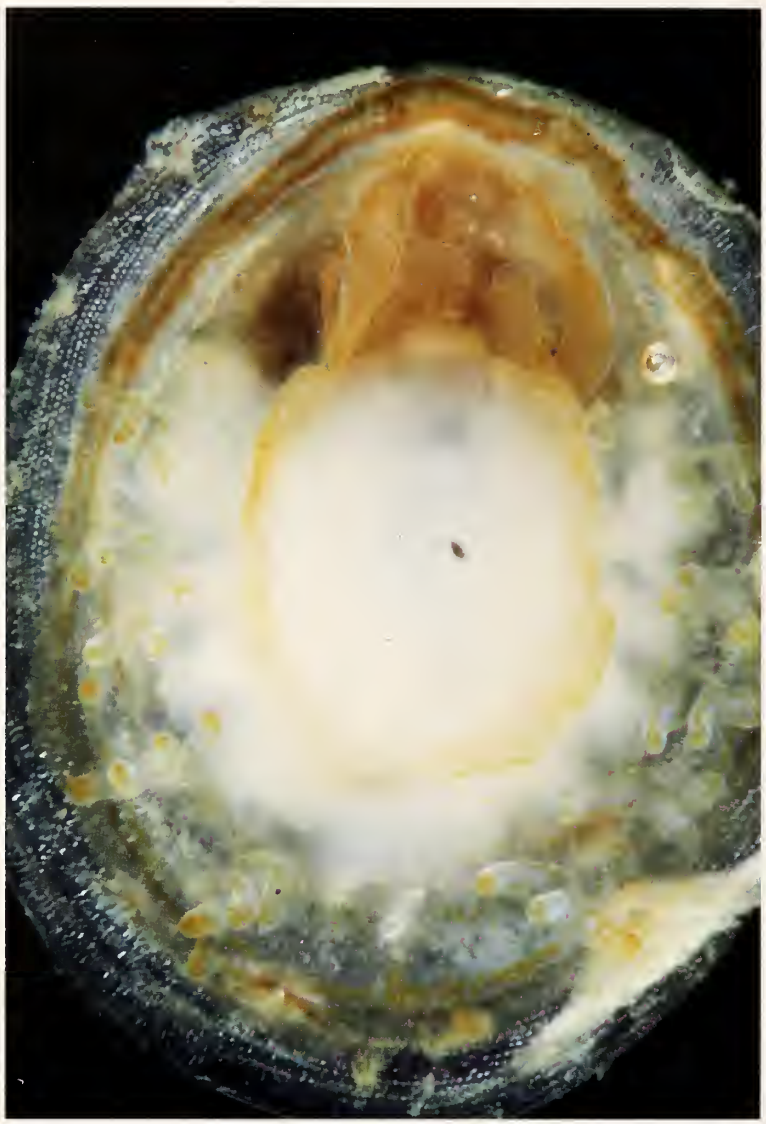


Explanation of Figures 15 to 18

Figures 15 and 16. *Laevipilina* ***antarctica***. Critical point dried bodies. Scale lines 200 μm. *Polarstern* station 173.

Figures 17 and 18. *Micropilina* ***arntzi***. Critical point dried bodies. Fragments of the periostracum are still attached to the pallial margin and the shell. Scale lines 100 μm. *Polarstern* station 173.

Key: A, anterior lip; E, embryo; F, foot; P, periostracum (pulled off from shell); PL, posterior lip; PT, postoral tentacles; S, shell; V, velum; 1–5, gills in numerical order.



Explanation of Figure 19

Figure 19. *Laevipilina* ***antarctica***, living specimen, diameter 3.0 mm. *Polarstern* station 212.

somewhat similar to a hay-rake, with about 50 lamellar hooks. Tooth number 4 has a truncated and serrated cutting edge. Tooth number 3 is slightly smaller than number 4 and has a laterally situated main cusp and about 6 or 7 more central denticles. Tooth number 2 is hand-shaped, with two apically and laterally situated primary cusps and some smaller denticles along the inner side. The central tooth is small, inconspicuous, ridgelike with a small apical cusp.

The large and conspicuous tooth number 5 is the last one to be formed during the continuous process of radular formation (Figure 14).

Remarks: The prismatic layer is barely visible in incident light, while the concentric sculpture dominates. In transmitted light the prisms are clearly visible (Figure 19).

The apical area (Figure 2) is probably a larval shell, as is indicated by the presence of a periostracum of which only patches remain. The periostracum was evidently continuous and covered all the shell, but a part of it still covers the transition from the apical area, over to the part of the shell that has concentric and radial sculpture.

Laevipilina ***antarctica*** differs from *L. hyalina* in having a less prominent central radular tooth and in having five instead of six pairs of gills, although the specimens are of

the same size. Another difference is that the prisms of *L. hyalina* are about as high as they are wide, while in *L. **antarctica*** they are distinctly shorter than they are wide. *Laevipilina rolani* differs in having more fully developed postoral tentacles, and in having a more convex shell, its height corresponding to half the length of the shell, while it is only 0.33 of the length in *L. **antarctica***.

The specific identification of monoplacophorans is still a problem since very few species are known from more than a single locality and several of the species belonging to genera of small species are very similar to each other. We are therefore not certain about the validity of the criteria used for their separation. It is even possible that *Laevipilina **antarctica*** belongs to one of the previously described species, although experience from gastropod limpets suggests otherwise.

In this connection it is significant to note that the number of digits on the gills varies with the size of the specimens, as mentioned in the description of the soft parts. The postoral tentacles, however, are identical throughout ontogenetic development, as far as could be seen.

Most specimens were found free in sediment samples brought home and sorted in the laboratory; only two specimens (from stations 158 and 212) were found on stones after intensive search of hundreds of stones of various sizes. This may be because they are scratched off the stones or crushed in the trawl by the surrounding bottom material. We therefore assume that all specimens had been living on stones or old shells, which were common in the bottom material of all stations.

One small specimen was serially sectioned to examine the stomach contents, which consisted of numerous mineral particles, unidentified organic material, scattered sponge spicules, radiolarian fragments, a small nematode, and a few polychete bristles.

The end of the radula that is in use shows conspicuous signs of wear. Most of the cusps of teeth numbers 1–4 are worn off to form a simple, rounded edge (Figure 27) instead of a sharp serration. This supports the assumption that *Laevipilina **antarctica*** obtains its food by scraping off the thin layer of sediment, which in these depths covers most hard surfaces.

Micropilina Warén, 1989

Micropilina Warén, 1989:2. Type species, *M. minuta* Warén, 1989, by original designation. Type locality, off southwestern Iceland, 900–926 m.

Remarks: The genus was based on a few empty shells, characterized by the shape, sculpture, and presence of distinct interior muscle scars. Marshall (1990) described a second species of the genus from north of New Zealand (Figure 1, number 18), from 1216–1385 m depth, known from a single shell.

The new species described here conforms well with a position in *Micropilina*. The shape is similar to that of the previously described species, and the sculpture is of the same construction, although finer.

The sculpture of the species of *Micropilina* bears some resemblance to that of the subapical part of the shell of *Rokopella* (Warén, 1988:figs. 3, 8), but it is too early to judge what this means about relationships, since the shell of most monoplacophorans has not been well enough illustrated to allow comparisons.

*Micropilina **arntzi*** Warén & Hain, sp. nov.

(Figures 9, 17, 18, 20–26, 28, 29)

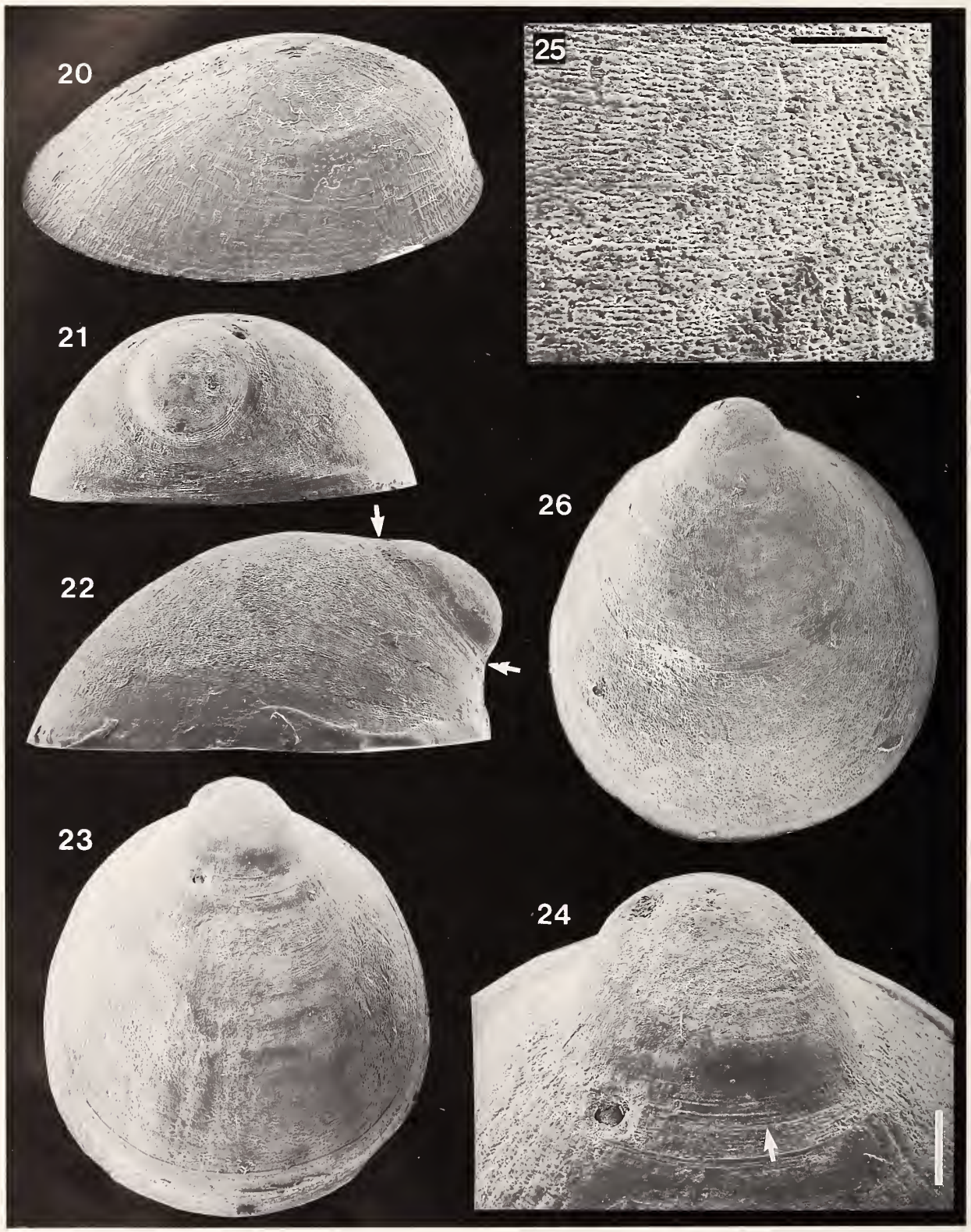
Type material: Holotype SMF 309780 and 5 paratypes SMF 309781, 20 paratypes SMNH 4380.

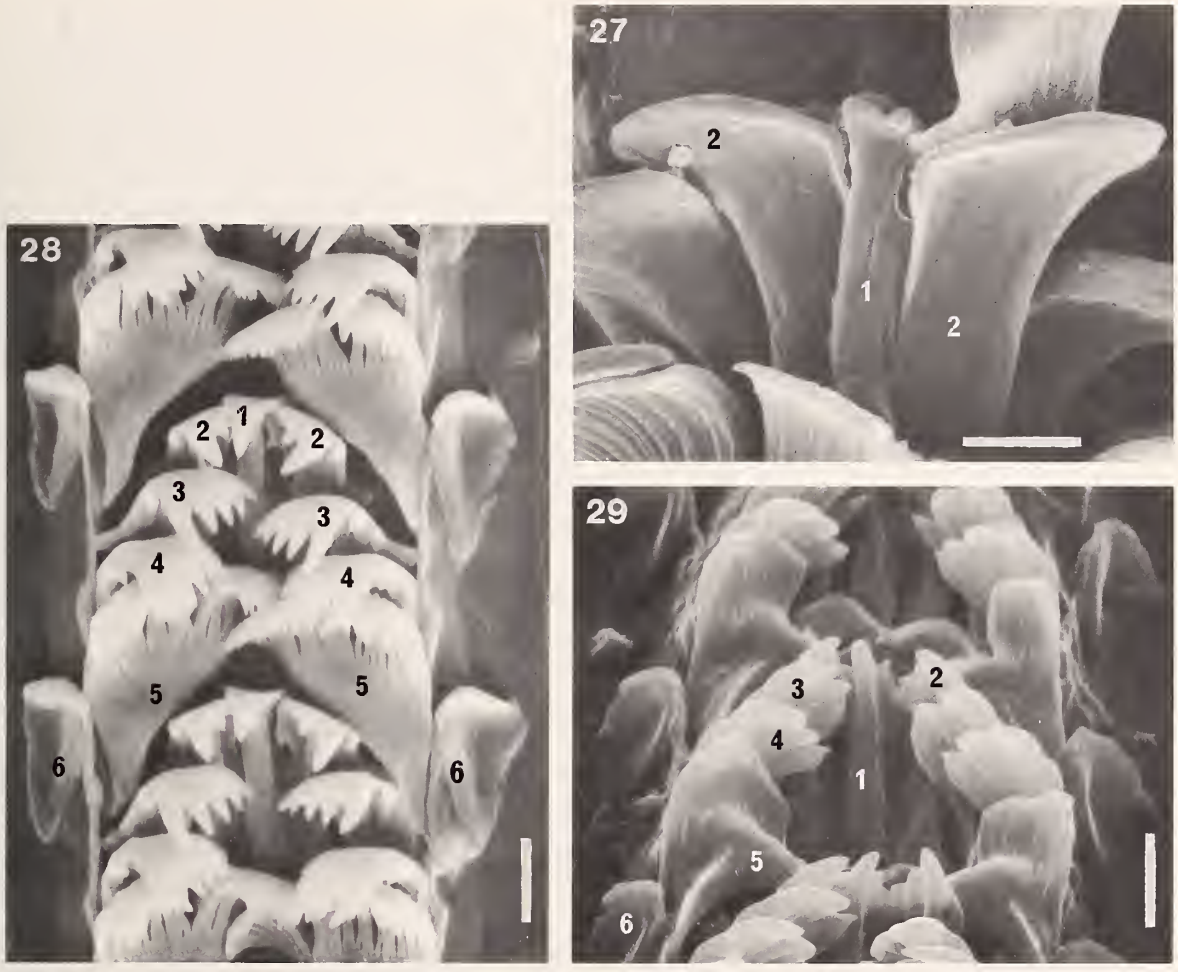
Type locality: R/V *Polarstern* ANT IX/3, station 173, 70°00.5′S, 07°09.1′E to 70°00.4′S, 07°07.4′E (end of haul), 739–765 m, 25 specimens, 10 shells, maximum diameter 0.92 mm.

Material examined: The type material and:

—*Polarstern* ANT IX/3, station 165, 70°18.9′S, 03°15.8′W to 70°19.2′S, 03°16.8′W, 191–204 m, silt with stones and rich megafauna, 1 shell, 1 specimen.
—*Polarstern* ANT IX/3, station 174, 69°43.7′S, 10°44.7′E to 69°42.4′S, 10°47.5′E, 432–432 m, silt with small stones, 7 specimens, 15 shells, maximum diameter 0.85 mm.
—*Polarstern* ANT IX/3, station 180, 69°57.4′S, 06°19.0′E to 69°57.7′S, 06°21.0′E, 280–298 m, 17 specimens, 1 shell, maximum diameter 0.88 mm.
—*Polarstern* ANT IX/3, station 206, 69°06.9′S, 10°01.0′E to 69°46.8′S, 10°01.6′E, 343–338 m, 1 shell.
—*Polarstern* ANT IX/3, station 207, 69°57.4′S, 05°08.4′E to 69°57.5′S, 05°00.4′E, 213–210 m, silt with scattered stones with rich megafauna, large quantities of the brachiopod *Magellania fragilis* Smith, 1907, 2 shells, 1 specimen.
—*Polarstern* ANT IX/3, station 211, 69°58.9′S, 05°08.4′E to 69°57.9′S, 05°00.4′E, 661–742 m, 5 shells.
—*Polarstern* ANT IX/3, station 212, 70°00.5′S, 03°56.4′E to 70°00.4′S, 03°57.3′E, 568–644 m, 4 specimens.

Descriptions: The shell (Figures 20–26) is very small, fragile, inflated, almost semiglobular with a large, bulbous apex and flat peristome. The apex (Figure 24) is mamillate and forms an angle of about 45° with the basal plane (Figure 22). There is no distinct sculpture on the slightly worn apical area, apart from occasional small pits, which also were seen in late, brooded young. This area measures 300 × 270 μm. Outside this area commences a fine, irregularly concentric striation (Figure 25), not visible with a stereomicroscope. In the furrows between the ridges are numerous small pits, diameter 2–5 μm. Under a stereomicroscope the whole shell has a seemingly granular surface, but this is caused by the pits. The shell is unusually


20
25
21
26
22
23
24



Explanation of Figures 27 to 29

Figure 27. *Laevipilina* ***antarctica***, central part of radula with worn edges of teeth number 1 and 2.

Figures 28 and 29. *Micropilina* ***arntzi***, radula, in perpendicular view and with stub tilted 45° to show the posterior surface of the cusps.

Teeth numbered 1–6 from central tooth (1). Scale lines 5 μm.

convex, with the apex well in front of the anterior edge and the highest point of the shell slightly anterior to the center of the shell. No muscle scars could be discerned on the interior. Slightly more than half the thickness of the shell consists of an interior nacreous layer (Figure 9), the exterior layer does not contain defined prisms.

Dimensions. Holotype 0.84 × 0.76 mm, height 0.38 mm. Maximum length of the shell 0.92 mm.

Soft parts (Figures 16, 18). The head is unusually large and bulging, with short, tapering, strongly ciliated velar lappets at the sides. The anterior lip seems to be very solid and cuticularized. Postoral tentacles are not present. The

←

Explanation of Figures 20 to 26

Figures 20–26. *Micropilina* ***arntzi***, shell. Figure 20. Fully developed juvenile from oviduct. Length 305 μm. *Polarstern* station 173. Figures 21–24. Anterior view, lateral view, dorsal view, and apex magnified. Length 0.92 mm. Scale line (Figure 24, only) 50 μm. *Polarstern* station 173. Figures 25 and 26. Dorsal view and sculpture. Length 0.85 mm. Scale line (Figure 25 only) 50 μm. *Polarstern* station 211.

White arrows indicate border of larval shell.

foot is round with a thickened rim. Three pairs of small, simple, tubercular gills are situated in the pallial groove and lack appendages. Five small, close-set muscle bundles, diameter 20–50 μm, can be seen with transmitted light, situated along the central third of the body and halfway between the midline and the lateral margin. Most specimens have one or two embryos under development, evidently partly contained in the opening of the gonoduct. The smallest embryos were ovate and of a diameter of about 100 μm, the largest ones 300 μm (Figure 20).

Radula (Figures 28, 29). The length of the radula slightly exceeds that of the shell. The outermost tooth (number 6) is scalelike with a smooth, rounded cutting edge. The large tooth (number 5) has about 20 or 25 hooks in the rakelike comb of teeth. Teeth numbers 4, 3, and 2 resemble each other and have 7, 6, and 4 cusps, respectively. The size of these three teeth diminishes towards the center of the ribbon. The central tooth (number 1) has a fully formed, tricuspidate cutting plate and a sturdy, narrow central supporting ridge.

Remarks: Among the monoplacophorans described so far, this one has been found in the greatest numbers, and it is the only one for which the mode of development is known. The young are evidently born at the crawling stage.

The increase in size of the embryos must mean that some kind of transfer of nutrients, supplied by the parent, takes place, but the mechanism is not known.

The radula of *Micropilina* ***arntzi*** is unusual in that the central and first marginal teeth are less reduced than in all other species for which the radula has been described. Those species have a radula that more closely resembles those of *Laevipilina* species.

ACKNOWLEDGMENTS

We want to thank the crew of R/V *Polarstern* for their assistance during the collecting program and Mme. J. Galeron at the Oceanographic Sorting Centre, Brest, where a part of the material was sorted. K. Rigneus (SMNH) sorted the material from *Polarstern* Cruise IX/3, A. Hedström (SMNH) prepared the serial sections of *Laevipilina* ***antarctica***, and C. Hammar (SMNH) prepared all photographic prints.

Drs. B. A. Marshall (Wellington) and J. H. McLean (Los Angeles) read and gave valuable comments on the manuscript.

LITERATURE CITED

Arntz, W., E. Ernst & I. Hempel. 1990. The expedition Antarktis VII/4 (EPOS leg 3) and VII/5 of RV "Polarstern" in 1989. Berichte zur Polarforschung 68:1–214.

Cesari, P., F. Giusti & A. Minelli. 1987. Recent monoplacophorans in the Mediterranean Sea: findings of *Neopilina zografi* (Dautzenberg & Fischer, 1896) off the Isles of Capraia, Gorgona, Corsica and Sardinia (Mollusca, Monoplacophora). Bollettino Malacologico 23:107–118.

Clarke, A. H. & R. J. Menzies. 1959. *Neopilina* (*Vema*) *ewingi*, a second living species of the Paleozoic class Monoplacophora. Science 129:1026–1027.

Dautzenberg, P. & H. Fischer. 1896. Dragages effectués par l'Hirondelle et par la Princesse-Alice: 1. Mollusques Gastéropodes. Memoires de la Societe Zoologique de France 10:139–234.

Filatova, Z. A., N. G. Vinogradova & N. I. Moskalev. 1975. Molluscs (*Neopilina*) in the Antarctic. Okeanologia 15:143–145.

Lemche, H. 1957. A new living deep-sea mollusk of the Cambro-Devonian class Monoplacophora. Nature 179:413–416.

Marshall, B. A. 1990. *Micropilina tangaroa*, a new monoplacophoran (Mollusca) from northern New Zealand. Nautilus 104:105–107.

McLean, J. H. 1979. A new monoplacophoran limpet from the continental shelf off southern California. Contributions in Science, Natural History Museum of Los Angeles County 307:1–19.

Menzies, R. J. 1968. New species of *Neopilina* of the Cambro-Devonian class Monoplacophora from the Milne-Edwards deep of the Peru-Chile Trench, R/V Anton Bruun. Marine Biological Association of India, Proceedings of the Symposium on Mollusca 1:1–9.

Menzies, R. J. & W. Layton. 1962. A new species of monoplacophoran mollusc *Neopilina* (*Neopilina*) *veleronis* from the slope of the Cedros Trench, Mexico. Annals and Magazine of Natural History 5(13):401–406.

Moskalev, L. I., Ya. I. Starobogatov & Z. A. Filatova. 1983. New data on the abyssal Monoplacophora from the Pacific and South Atlantic oceans. Zoologeski Zhurnal 112: 981–996.

Peel, J. 1991. Functional morphology, evolution and systematics of early Palaeozoic univalved molluscs. Grönlands Geologiske Undersögelse, Bulletin 161. 116 pp.

Rokop, F. J. 1972. A new species of monoplacophoran from the abyssal North Pacific. The Veliger 15:91–95.

Rosewater, J. 1970. Monoplacophora in the South Atlantic Ocean. Science 167:1485–1486.

Taviani, M. 1990. A fossil Coenozoic Monoplacophora. Lethaia 23:213–216.

Tebble, N. 1967. A *Neopilina* from the Gulf of Aden. Nature 215:663–664.

Warén, A. 1988. *Neopilina goesi*, a new Caribbean monoplacophoran dredged in 1869. Proceedings of the Biological Society of Washington 101:676–681.

Warén, A. 1989. New and little known Mollusca from Iceland. Sarsia 74:1–28.

Warén, A. & P. Bouchet. 1990. *Laevipilina rolani*, a new monoplacophoran from off southwestern Europe. Journal of Molluscan Studies 56:449–453.

Wenz, W. 1940. Ursprung und frühe Stammesgeschichte der Gastropode. Archiv für Molluskenkunde 72:1–10.